Multidimensional observation methodology for the elderly in an ambient digital environment

Adrien Van den Bossche[1], Eric Campo[2], Jenny Duchier[3], Elizabeth Bougeois[4], Mathilde Blanc Machado[1], Thierry Val[1], Frédéric Vella[1], Nadine Vigouroux[1]

[1] IRIT-CNRS, Université de Toulouse, CNRS, UPS, UT2J, Toulouse, France
[2] LAAS-CNRS, Université de Toulouse, CNRS, UT2J, Toulouse, France
[3] INSERM, UMR 1027, Université de Toulouse, UPS, Toulouse, France
[4] LERASS, Université de Toulouse, UT2J, Toulouse, France

{Mathilde.Blanc-Machado,vella,vigourou}@irit.fr, {vandenbo, eric.campo,thierry.val, elizabeth.bougeois}@univ-tlse2.fr, jenny.duchier@inserm.fr

Abstract. This paper proposes a new methodological approach for a better understanding of the needs of elderly people the use of the technology in the use of technologies in an ambient. This methodology is based on the implementation of a multidimensional observation tool mixing ethnographic observation of actions and interviews with a multitechnological infrastructure in a Living Lab. Some preliminary results are presented with the participation of 14 seniors.

Keywords: Ambient digital environment, multidimensional observation, elderly people, Living Lab.

1 Introduction

Ambient Assisted Living (AAL) aims to provide assistive solutions for old people with a wide range of physical and cognitive challenges. Many efforts have been made to increase accessibility to these assistive technologies for older people but the solutions are not yet at the appointment in particular due to the lack of study of the real needs and a clear definition of the elderly profiles (dependent, frail, socially isolated, digital exclusion, etc. [1]). Some specific characteristics prevent or put a brake on the access to these new technologies. The behavior and interaction modes of these people in the use and access to these technologies are not fully understood because of the many influencing factors. Several challenges of the ambient intelligence [2] are to be overcome. Although several innovative technologies have been developed, there is still a strong need to research exploring new design of interaction as well as wireless network tools [3].

A significant challenge when studying technologies within the True Life Lab concept [4] is the ambient living where the research is carried out to inform about the acceptability of future innovative technologies or services.

Designing these future technologies can be complicated even if there are ways of including the participant to imagine current uses and interactions: these technologies are new and their potential uses by the participants are yet unknown. Also, the

integration of technologies and services in an ambient intelligence must be thought as a whole in a user-centered approach in this double dimension: use and "Usability". A digital environment must be defined as sensitive, responsive and adaptive to the changeable needs of its inhabitants [5]. Moreover, Sun et al. [6] claim that participant involvement is a “key ingredient towards effective AAL, which not only saves social resources but also has positive influence on the psychological health of the elderly people”.

Numeric ambient platforms are essential to understand better how information and communication technologies (ICT) can enable to help people in daily activities and to maintain them in their environment as long as possible.

Even though a lot of research has been published about the monitoring of activities in a home dedicated to experimental studies, including wireless sensors [7] or cameras that allow activities extracted from sensors and matched with video observations, these approaches are not sufficient to address the challenges of AAL [2].

That is why complementary methods and tools from social sciences and information and communication technologies need to be merged to explore and analyze behavior of participants with these innovative technologies to design, adapt them, based on related ICT experiences and socio-cultural profiles. It is also important to consider how a new numeric ambient technology including several intuitive interactions based on gesture, tactile and speech (Fig. 1) could fit the profile of the participant.

Therefore, a methodology [7] mixing ethnographic observation [9] of actions and interviews [10] needs to be investigated. This innovating methodology must take into account several restraints, for instance that the elderly people could not endure a long experimentation time and could be stressed by the numeric ambient environment.

This paper describes a methodology based on the implementation of a multidimensional observation tool mixing ethnographic observation of actions and interviews, with a multitechnological infrastructure in a living lab. Some preliminary validation results are shown.

The paper is organized as follows: Section 2 describes the method and observation tools. Section 3 presents the research protocol. Section 4 gives the preliminary results. Section 5 gives a first discussion. Section 6 concludes the paper.

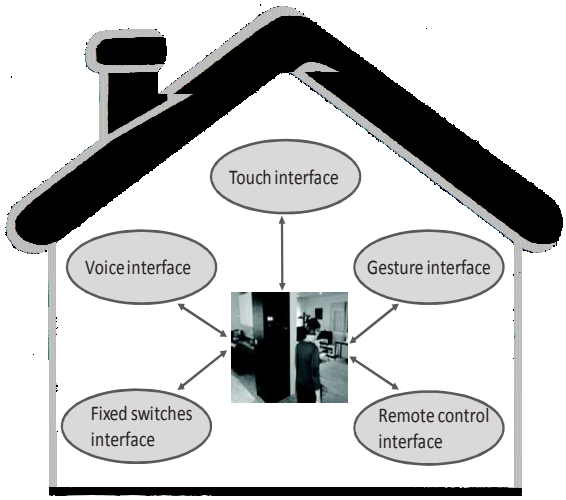

Fig. 1 Interactions in a smart home

2 Method and observation tools

This section aims to present the method and tools developed in a multidimensional platform and the transdisciplinary protocol used for the experimentation.

2.1 Ethnography and communication communication sciences

The social sciences process of the study is inductive, based on grounded theories, and centred on the uses, practices and representations of a person testing a technological environment. The association of ethnography and communication enables us to gather data about what people do and how, in order to understand why they do so. The analysis of the qualitative data is focused both on the actions performed by elderly people and their behaviour during the observation stage, and on their discourse about their experiment, during the interviews. This analysis thus gives comprehensive elements of the way elderly people consider the use of ambient technologies dedicated to palliate the loss of autonomy.

2.2 Observation platform architecture

A monitoring tool has been set up, to assess, from an objective and multidimensional way, the behaviour of people in a semi controlled environment. The test environment MIB (smart home of Blagnac technological Institute) [11] is fully automated and proposes different modalities of interaction (speech, tactile, fixed switches interfaces)

between the inhabitant and his habitat to allow monitoring, control, information exchange.

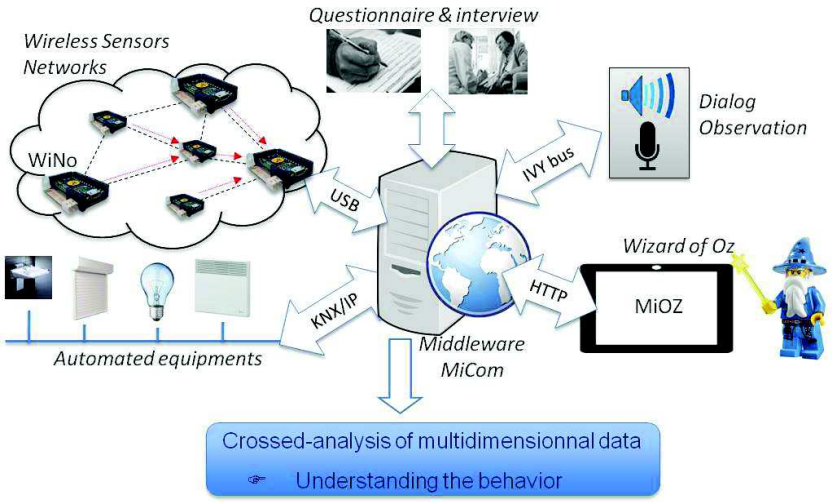

Fig. 2 Observation platform architecture

The observation platform (Fig. 2) is made from an audio and video network with IP-cameras and microphones, and several communication technologies such as KNX (classical home automation bus), Ivy [12,13] (bus-software used commonly used in the Human Computer Interaction context. Here, it is used to manage the Text-To-Speech system), WiNo [3] (Wireless Node) and web-based (HTTP, HTTPS) devices such as tablets or proprietary sensors (bed presence, moving sensors, etc.) and actuators (lights, bed, height adjustable sink and cupboard in the kitchen, etc.).

The various technologies induce a heterogeneity that is close to a real-life situation and needs an important interoperability. To solve the interoperability difficulty, a specific lightweight Middleware "MiCom" has been developed. MiCom enables connections with various technologies and proposes a HTTP-based command set to interact with sensors and actuators, regardless of the communication technology. Every device of the environment can be managed by calling HTTP URLs. Thus, the development of software components such as home automation controllers or Wizard of Oz, to simulate dialog between the inhabitant and the smart home, is easier and more effective.

The MiOZ interactive system is a Wizard of Oz platform. It was designated to simulate the spoken dialogue management between the inhabitant and the smart home. It can send and receive orders and feedbacks to sensors, actuators... regardless of the communication technology available in the smart home of Blagnac technological Institute. Thanks to this system, the experimenter can track the participant's actions, interact with him/her when it is necessary and simulate the smart home voice by means of a text-to-speech system.

2.3 Towards a transdisciplinary research protocol

The transdisciplinary dimension of this approach leaded to the construction of a peculiar research protocol, within which quantitative and technical data and qualitative analysis are interconnected. A cross-analysis of the results must allow assessment of the contribution of digital technologies in the improvement of living conditions and strengthening autonomy at home. Table 1 summarizes the different tools implemented in the observation platform.

Table 1. Methods and tools used

Tools	Information collected
Questionnaires	Sociological profile, potential impairments, interest and use of technologies, expectations
Video observation	Monitoring of human behavior in an automated environment (smart home)
Dialogue recording	Dialogue between participant and digital environment
Semi-structured post experimentation interviews	Interviews about expectations and new-visions about technologies
Log file	Data of sensor, tactile interaction

3 Research protocol

The people recruited to participate to this project are aged of 60 years and more, retired and voluntary. No selection is made concerning cognitive diseases. According to the charter of use of personal data, the participants have to sign a consent letter to prove that they agree with the study and the use of their data that are backed up anonymously. Up to three participants are called on a half day during which researchers accompany them. First, they have to answer a questionnaire to determine their socio-cultural profile, their use of ICT or their intention of using new technologies and their projections about aging. Then, they attend a presentation on the different technologies and services offered by the smart home and, individually, they are asked to use freely this controlled housing for a limited duration of ten minutes in accordance with the protocol. The only instruction for the test is to simulate the usual scenario of their awakening as they realize it every morning, that's to say to carry out the same activities and to replicate their habits as when they wake up in the morning in their home. In this way, they can use classic switches to act on home equipment and/or tactile interface on tablets, to perform the same actions as conventional switches, and/or voice control of the MIB. No example of voice interaction is specified to participants; the aim how people speak to a simulated intelligence to act on their habitat. After the test in the smart home, they are interviewed by researchers in human and social sciences who have observed them during the scenario in the

MIB, in order to understand their behavior during the testing and discuss about their feelings and projection in the use of ambient technologies. For this, we have tried out the protocol with 14 participants (5 men and 9 women).

4 Preliminary results

All data (text messages of the smart home, information from sensors, tactile interaction log and speech) of the participant are saved in a secured database. These data will be matched with the observations.

The 14 people enjoy the experiment. At the beginning of the pre-testing phase, women mainly, showed little anxiety. However, most of the participants found that the smart home was “amazing”, or “magic”. The participants appreciate the vocal interaction, which seems to be their favourite tool, because it gives both additional sensitivity and extra soul to a technological environment. The participants living by themselves qualify their satisfaction in terms of “humanity of the smart home voice”. They think that, with such a tool, one can feel less lonely. They say that the voice is warm, friendly, hearty. The technologies tested during the experiment often appear to the participants as a means of independence and a way to avoid going to a nursing home. However, some of them criticize those technologies because they think that these kinds of equipment might make one lazy; they also express the fact that they want to remain “master at home”. Some participants found that this environment was too “medicalized”, others wonder about the system reliability or costs at home. However, this cost is never precisely expressed; it is imagined and constitutes a representation which leads to detachment from technologies at home.

Even though the participants declare themselves as “concerned” and “convinced” by the smart home, they also say that they don’t need it immediately but in the future. Some of them clearly express their difficulty to project themselves into the loss of autonomy. They do not seem to anticipate their future, except those who already have the experience of a member of the family who suffers or suffered any kind of illness.

This may be analyzed as ambivalence, or reluctance about palliative technologies as far as free and independent aging is concerned.

During the interviews, some participants have a contradictory discourse, compared to their behaviour during the experiment, such as, for instance, being very keen about the voice control and not using it at all. However, this experience has changed positively their perception of new technologies.

As far as installing a technological device at home is concerned, there is a significant difference between owners and tenants of their home: tenants are not interested, as they either can’t invest, or their home is not suitable for installation, or they know that they will have to leave it for a nursing home if they become dependent.

5 Discussion

After this pre-testing phase, the methodology and tools have been adjusted. It appeared necessary to focus more on the participants, from an ethical concern, in order to prevent stress and anxiety. The presentation of the smart home was first quick and standardized, it is now longer and more humanized, incarnated: a technical researcher of the team shows the different equipment and explains their use.

An appropriation phase of the different interaction modes –switches, tactile tablet, speech input and speech synthesis– has been added: each participant individually learns and tests them, with the eventual help of a researcher. Some speech messages have been redefined in order to increase their intelligibility and their understanding (better taking into account of the limits of the synthetic voice, such as lack of links between words, bad pronunciation, and use of synonymous) by the inhabitants. New contextualized messages were also added to give greater flexibility and natural to the dialogue.

The immersion in a technological environment is thus facilitated; the participants are ready to realize the scenario described in section 3.

The data of home automation equipment –sensors, roller blinds, motorized furniture, lights– correlated with observations allow us to track all displacements and activities realized by each participant during the scenario. Some motion sensors have been repositioned in the apartment to improve the acquisition of data.

6 Conclusion

This paper proposes a new methodological approach for a better understanding of the needs of elderly people and the use of the technology in an ambient digital environment. This approach is based on the implementation of a multidimensional observation tool. The participants were immersed in an ambient environment in which they could understand and use different technologies to control it: voice, tactile, switches. They were able to perceive how technologies could help them, anticipate the occurrence of a possible impairment or loss of autonomy and thus enable them to stay in their homes. The first analyzes show that the projection into the future is not so obvious. Technological and methodological adjustments were made for a better understanding of the potential uses of ambient technologies elderly people express. The explanation of the technology used was also more detailed.

The next step is to carry on the experiments with 150 people who will try out the different interaction modes proposed. This next phase will enable us to consider different profiles or ideal-types of inhabitants or mode of connected settlements.

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References

1. Chappell, N.L., Cooke, H.A.: Age Related Disabilities - Aging and Quality of Life. In: JH Stone, M Blouin, editors. International Encyclopedia of Rehabilitation. Available online: http://cirrie.buffalo.edu/encyclopedia/en/article/189/ (2010)
2. Coughlan, T., Mackley, K.L., Brown, M., Martindale, S., Schlögl, S., Mallaband, B., Arnott J.: Current Issues and Future Directions in Methods for Studying Technology in the Home. PsychNology Journal; 11(2), 159-184 (2013)
3. Van den Bossche, A., Dalce, R., Val, T.: OpenWiNo: An Open Hardware and Software Framework for Fast-Prototyping in the IoT, International Conference on Telecommunications, Thessaloniki, IEEExplore digital library, (electronic support), 16-18 may (2016)
4. Vigouroux, N., Rumeau, P., Boudet, B., Vella, F., Salvodelli, M.: Wellfar-e-link®: true life lab testing of a homecare communication tool, In: Non-pharmacological Therapies in Dementia, Nova Science Publishers; 3(2), 133-142 (2015)
5. Bierhoff, I., van Berlo, A., Abascal, J., et al.: Chapter 3. "Smart home environment", Towards an inclusive future: Impact and wider potential of information and communication technologies. In: Roe P.R.W. (ed.), pp. 110-156 (2007)
6. Sun, H., De Florio, V., Gui, N., Blondia, C.: The missing Ones: Key Ingredients Towards Effective Ambient Assisted Living Systems, Journal of Ambient Intelligence and Smart Environments archive, 2(2), 109-120 (2010)
7. Suryadevara, N.K., Gaddam A., Rayudu, R. K. and Mukhopadhyay, S.C.: Wireless Sensors Network Based Safe Home to Care Elderly People: Behaviour Detection, Proc. Eurosensors XXV, September 4-7, 2011, Athens, Greece, pp. 96-99.
8. Olivier de Sardan J.-P.: *Epistemology, Fieldwork, and Anthropology*. Palgrave MacMillan (2015)
9. Goffman, E.: The Interaction Order, American Sociological Review, 48: 1-17 (1983)
10. Corbin, J. and Strauss A.L.: *Basics of Qualitative Research : Techniques and Procedures for developing Grounded Theory* (4th ed) San Jose State University, Sage (2015)
11. Campo, E., Daran, X., Redon, L.: Une maison intelligente au carrefour des sciences technologiques et des sciences humaines. In : 2nd Int. Conf. sur l'accessibilité et les systèmes de suppléance aux personnes en situation de handicap; Paris, France, pp.33-42 (2011)
12. Buisson, M., Bustico, A., Chatty, S., Colin, F.R, Jestin, Y., Maury, S., Mertz, C., Truillet, P.: Ivy : Un bus logiciel au service du développement de prototypes de systèmes interactifs. In: IHM 2002, Poitiers, 26/11/2002-29/11/2002, ACM Press, pp. 223-226 (2002)
13. IVY's web site, http://www.eei.cena.fr/products/ivy, last accessed Feb 2016